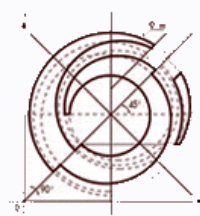


August 17, 2005

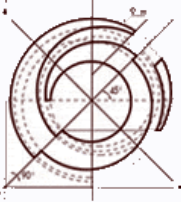
California Energy Commission
Committee Workshop on Clean Coal Technology
and Electricity Imports
**What Are the Challenges to Building a Clean
Coal Plant in the Western United States?**

Kevin E. Taugher

ALSTOM



- Plant site considerations
- Permits
- Financial drivers
- Criteria pollutants
- Opportunity to upgrade existing plants
- CO₂

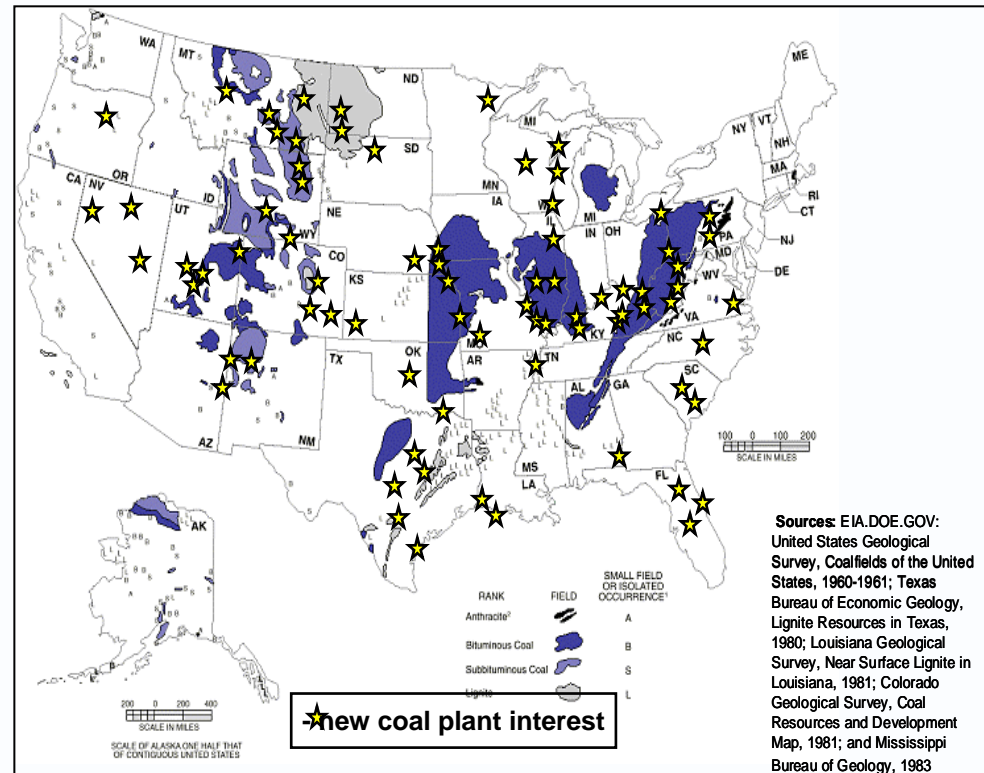
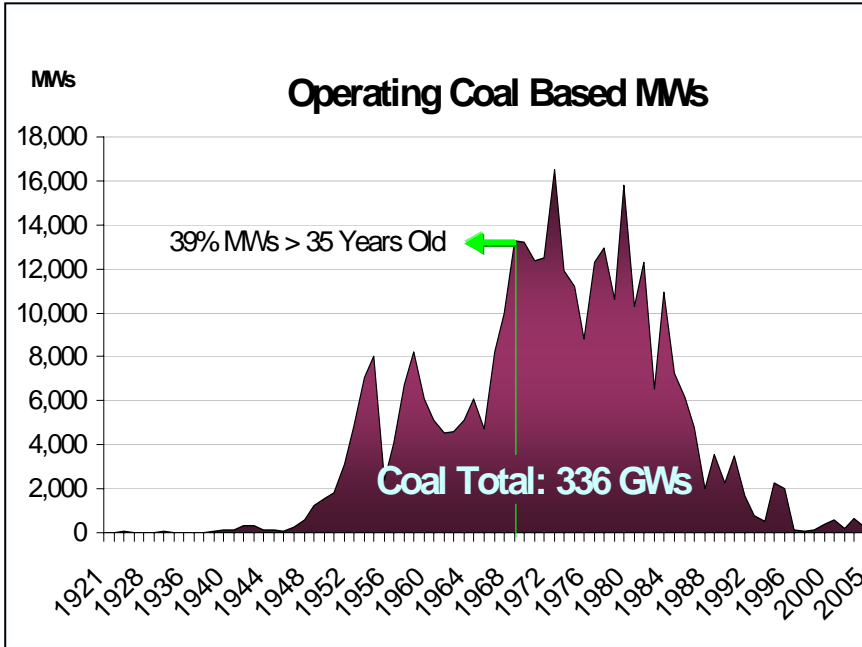


Electricity Supply Forecast

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To supply the demand for Coal Growth

1. New Additions
2. Improve the Ageing 336 GW Fleet



* Source: EIA Reference Case forecast
Annual Energy Outlook 2005 Table A8



Typical Permits

- **Air Permitting Issues:**

- NSPS
- BACT Analysis
- PSD/Visibility Modelling
- PM2.5 Non-Attainment
- Permit Application Review Process

- **Wastewater Permitting Issues:**

- Effluent Guidelines Applicability
- Permit Application Review Process

- **Landfill Permitting Issues:**

- Geo-Technical Evaluations
- Environmental/Archaeological Studies
- Permit Application Review Process

- **US Army Corp of Engineers Permitting:**

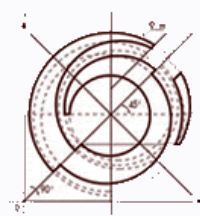
- Environmental/Archaeological Studies
- Section 10 and 404
- 401 Water Quality Certifications
- Permit Application Review Process

- **NEPA Process:**

- Applicability
- Environmental Assessment/Impact Studies

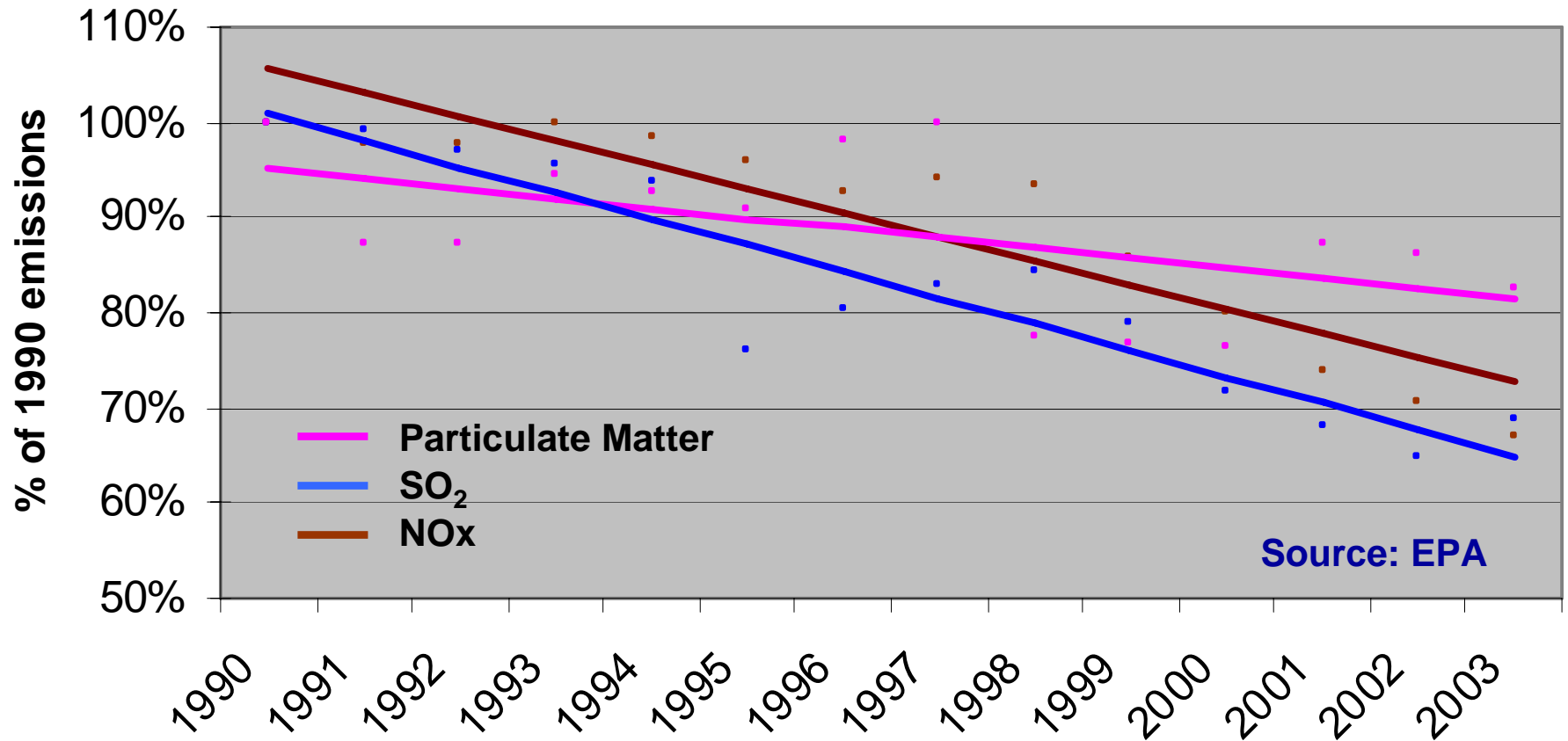
- **State Utility Commissions & Power Siting Boards:**

- Certificate of Need and Necessity
- Certificate Application Review Process

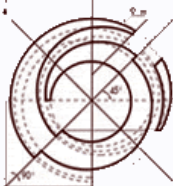


- **Environmental**
 - Near zero emissions
- **Economics**
 - Utilization of all low cost domestic coal resources
 - Most competitive conversion costs
 - Track record of performance
- **Operations**
 - Highest reliability and commercial availability
 - Operating parameters appropriate for grid based generation

While Coal Generation increased, Emissions have declined



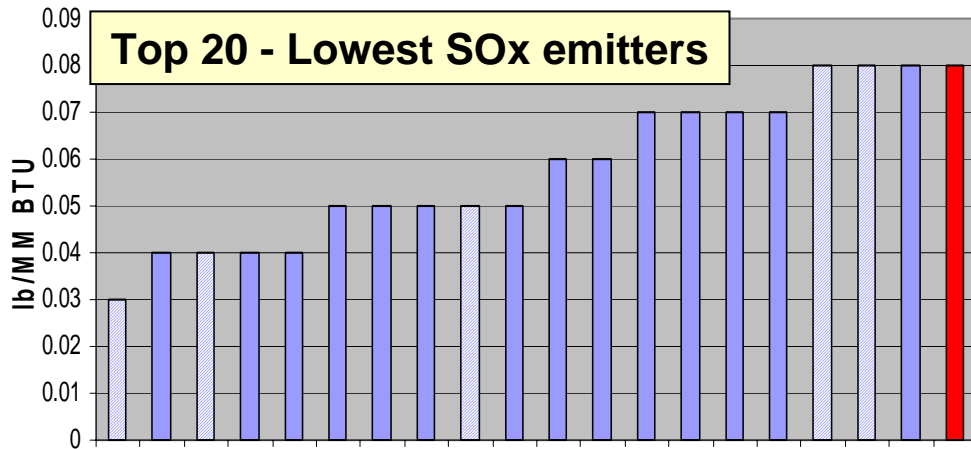
□ Once emission goals are set, Technology can deliver: reliably and economically



Technological Aspects of Generation Options: Advanced Coal Combustion - Emissions

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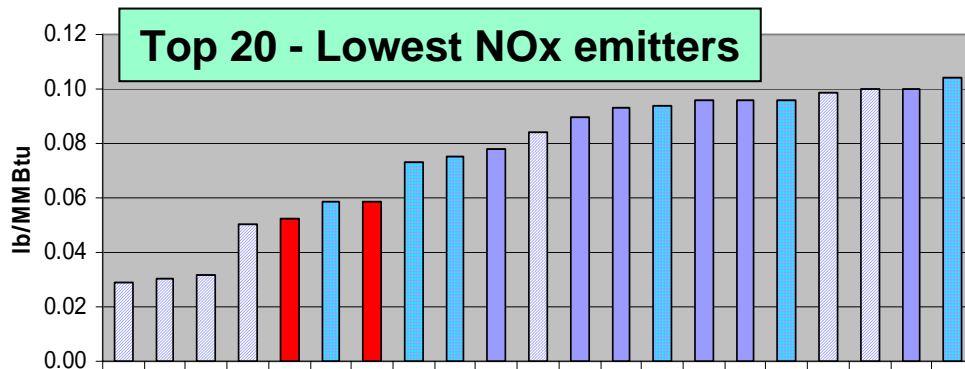
2004 SO₂ annual avg emissions rates - US coal units



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F dndq# F rdd# hfkgrarj lrv#
kdyh# ghp rqrw dwhg# kh#
arzhw# hp lvrqv:*

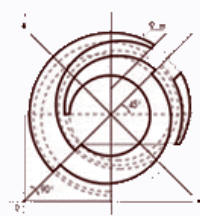
- Exceed Requirements
- Cost Effectively
- Reliably

2004 NO_x annual avg emissions rates - US coal units



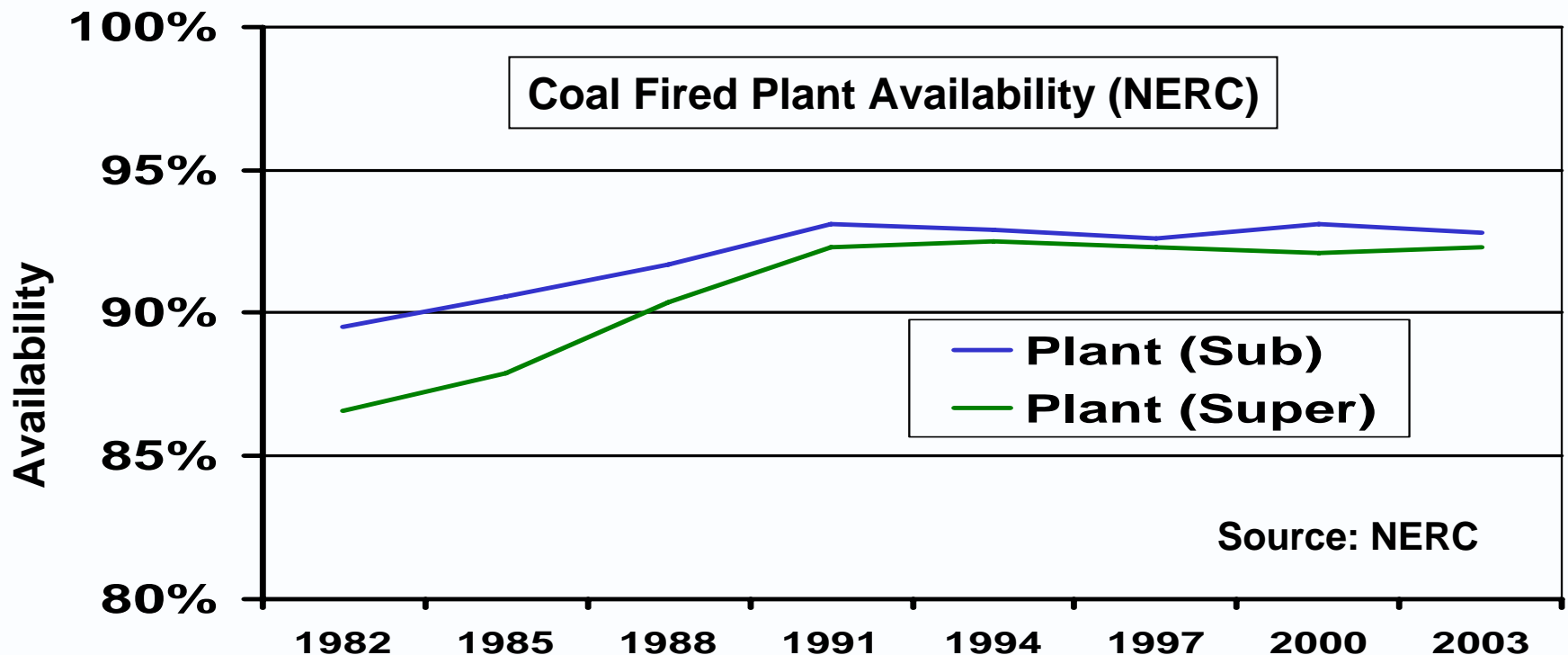
- Bit. PC
- SubBit. PC
- CFB
- IGCC (Wabash & Polk)

Source: Energy Velocity database (CEMS)



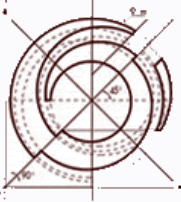
Availability: Key for Capital intensive, Base Load Generation

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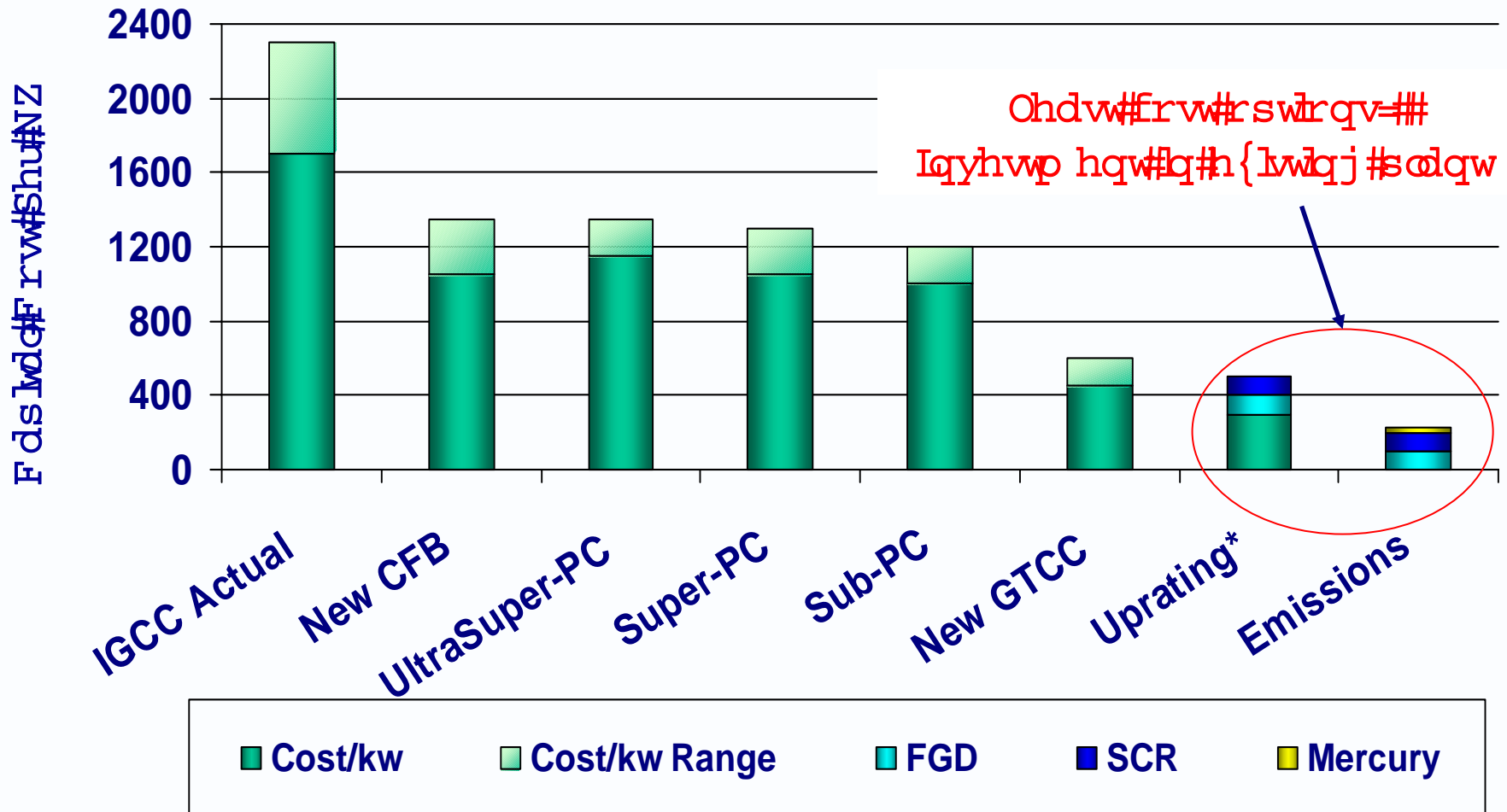
PC/CFB plants have a proven track record:

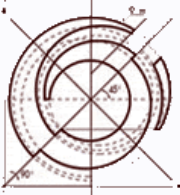
- Reliability and availability is well documented by US NERC and international energy agencies



Generation Options: New plant cost & Potential from Existing Units

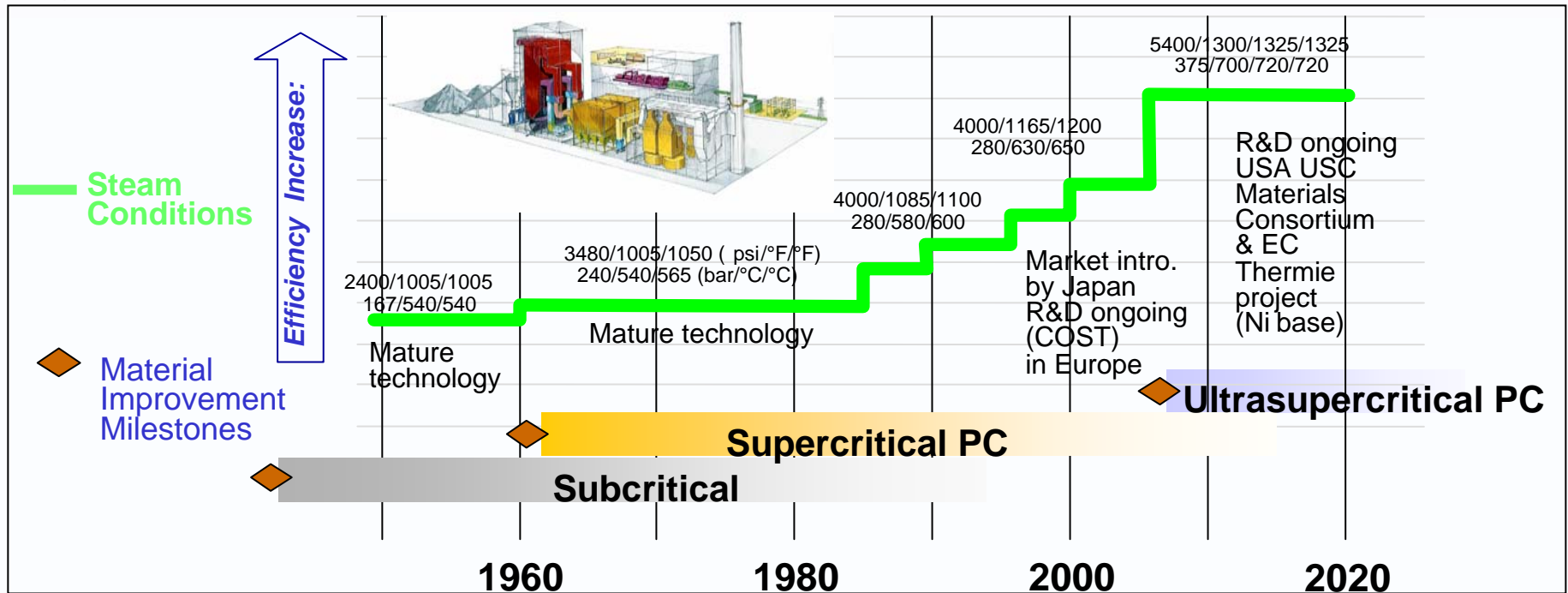
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Technological Options: Advanced Coal Combustion - Efficiency

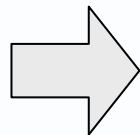
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Advanced cycles - A proven path to reliable, high efficiency power generation

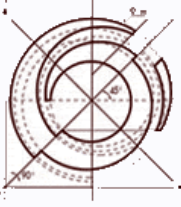
Current Operation

- Supercritical: 38% - 40%
- IGCC: 35% - 38%



Potential

- UltraSupercritical: 43% - 45%
- Future IGCC: 38% - 45%



Three Areas of Focus:

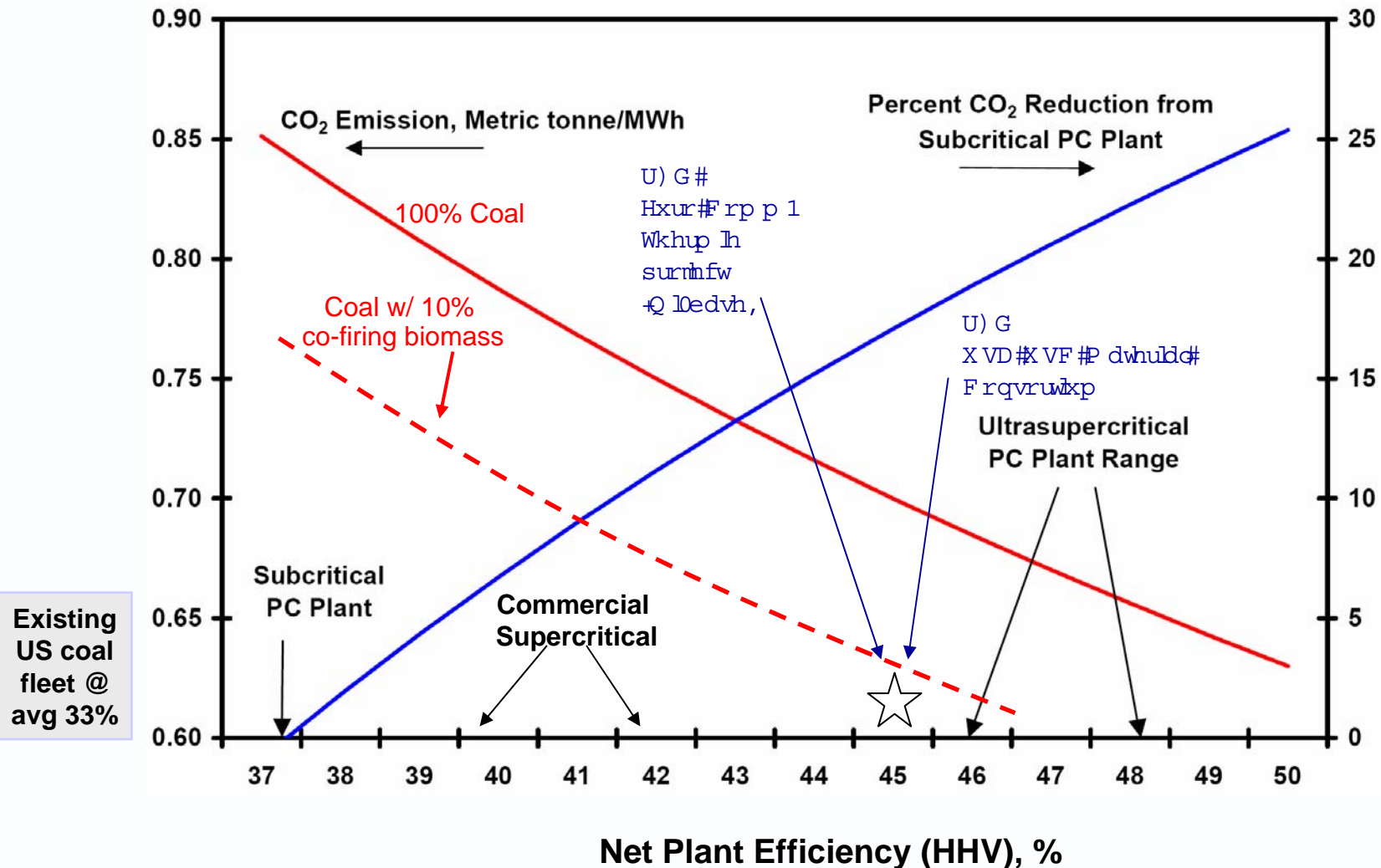
1. Minimize Production through Efficiency
2. Capture
 - Developing Numerous In-Furnace and Backend Solutions
 - Cost Target: \$10/ton CO₂
 - 3 to 7 year Time Frame
3. Disposal
 - How? → Sequestration ?
 - Where?
 - What are the Guidelines?

**But, No Matter Which
Technology:
 $C + O_2 = \text{Energy} + CO_2$**

Increased Efficiency Reduces CO₂



Carbon Dioxide Emissions vs Net Plant Efficiency
(Based on firing Pittsburgh #8 Coal)





Technology driven, Economically acceptable Options:



- Low, long term operating costs are enabled by the abundance of relatively low cost domestic coal reserves
- Proven, reliable and economical PC and CFB Clean Coal technologies minimize both capital and operating cost risk
- PC and CFB Clean Coal technologies have demonstrated the lowest emissions
 - Continuing to advance state of emissions reductions
 - Technology for existing fleet: NO_x , SO_x , Particulate, Hg
- Supercritical steam cycles provide a proven path to high efficiency / low CO_2
- Each of the technologies can be made CO_2 ready

Advanced Coal Combustion

– still the viable technology for clean power



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